

following changes at the chondro-osseous junction of the ribs of the growing guinea pig: (1) The preëxisting resting and columnar cartilage cells undergo hyperplastic and hypertrophic changes which are associated with certain retrogressive processes in the cells. (2) In the cells of the perichondrium and periosteum a pronounced hyperplasia takes place followed by an accelerated conversion of these cells into cartilaginous tissue with subsequent calcification. (3) The bone marrow becomes transformed into fibrous connective tissue in which cartilaginous islands develop in places adjoining the hyperplastic cartilage. Through the coöperation of both these growth processes an abundance of cartilage may develop.

We find various transitions between ordinary hypertrophy and hyperplasia of the preëxisting cartilage cells to the formation of a rosary-like newgrowth. In advanced cases, at a time when usually the growth of the skeleton is terminated, the formation of tissue may become so very extensive that it leads to the production of a parosteal "rosary". These changes are very similar to those described by Erdheim³ in cases of human acromegaly. They also correspond to the alterations observed by us in the cartilage of the epiphyseal line and the joint following injections of the extract over shorter periods of time. These changes may be even more marked in thyroidectomized than in non-thyroidectomized animals, which provides further proof for the conclusion that, in guinea pigs, cattle anterior pituitary extract acts on the growth of bone and cartilage without the mediation of the thyroid gland.

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The Fibro-Muscular Scrotal Sac Under Normal and Experimental Conditions in an Annual Breeder (*Citellus*).*

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What causes the testis of an adult ground squirrel to ascend into the peritoneal cavity during the non-breeding period? Is decrease in testis-size a primary factor, or does the scrotum regress and force the testis to ascend? The scrota of 89 ground squirrels (*Citellus*

³ Erdheim, J., *Veröffentlichungen a. d. Gebiete d. Pathol. in Einzeldarstellungen*, Julius Springer, Berlin, 1931.

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tridecemlineatus) have been studied in an attempt to answer these questions. Details concerning the normal sexual cycle in the male are presented elsewhere.^{1, 2}

The present report deals largely with the muscular pouch which incloses testis and epididymis, designated in this paper by the name "fibro-muscular scrotal sac" (Fig. 2). This sac is composed of the following layers: peritoneum, internal spermatic fascia, cremasteric skeletal muscle and external spermatic fascia (Figs. 1, 3). The fibro-muscular sac of each animal was freed of its contents, severed at the inguinal ring (Fig. 3), weighed while fresh, fixed in Bouin's solution and sectioned at 6 micra for microscopical study.

The scrotal sac of prepuberal males undergoes a gradual increase in weight (Table I). The sacs of adults are large in males with large scrotal and spermatic testes, and are greatly reduced in size in animals having small, abdominal and aspermatic testes. Weight

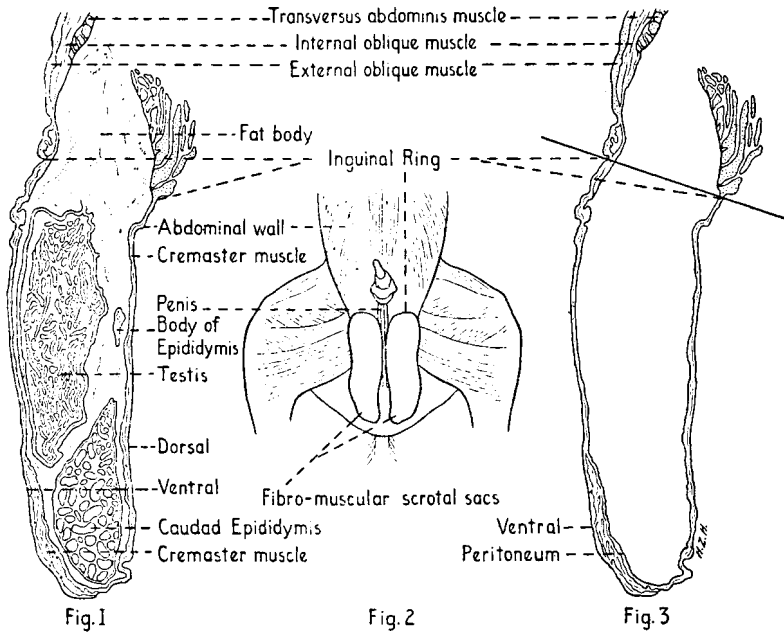


Fig. 1

Fig. 2

Fig. 3

FIG. 1.

Longitudinal section through abdominal wall and fibro-muscular scrotal sac. Contents of sac intact. $\times 2.3$.

FIG. 2.

Ventral view of ground squirrel with skin and superficial fascia removed. $\times 1/2$.

FIG. 3.

Same as Fig. 1 with sac contents omitted. Sac routinely severed at level of solid line for weighing. $\times 2.3$.

¹ Johnson, G. E., Foster, M. A., and Coco, R. M., *Trans. Kans. Acad. Sci.*, 1933, **36**, 250.

² Wells, L. J., *Anat. Rec.*, 1935, **62**, 409.

of paired sacs in males with spermatozoa ranged from 0.1212 to 0.5215 gm., yet this weight was slightly less than the average for males lacking spermatozoa in only 2 of 32 cases. The greatest weight of paired sacs in any aspermatic male was 0.2400 gm., and this is significantly less than the average weight for animals with spermatozoa. Data for individual animals indicate clearly that variations in sac weight lag behind variations in testis weight. The testis may be experimentally caused to remain spermatogenetically active within the scrotum during the non-breeding period by subjection of the animal to cold temperature and darkness³; such males have large scrotal sacs.

TABLE I.
Weight of Fresh Fibro-muscular Scrotal Sacs of Unoperated Males.
Data expressed as averages for each group.

Age	Month of Autopsy	No. of Animals	Body Wt., gm.	Fresh Wt. of one testis, gm.	Sperma-tozoa	Weight of 2 scrotal sacs, gm.
Adult	Jan.-May	32	228	.8654	Present	.3338
	June-Dec.	18	208	.1320	Absent	.1338
	Aug.-Dec.*	8	190	.8515	Present	.3044
Young	August	4	137	.0453	Absent	.0438
	October	2	174	.1905	"	.1440
	January	1	222	.3475	"	.1717

*Experimental animals exposed to constant temperature of approximately 4° C.

Microscopical studies indicate that weight of the fibro-muscular sac depends on the amount of skeletal cremasteric muscle. Whether variation in the amount of muscle is due to hypertrophy or hyperplasia, or both, has not been determined, but this question is being investigated.

The fibro-muscular sac has been experimentally emptied of its contents by unilateral castration and by production of unilateral cryptorchidism, in prepuberal males. Such animals were operated during September-October and autopsied during February-March when the untreated testis had become large, scrotal and spermatic. The empty sac was invariably small in comparison with the normal contralateral one (Table II). These experiments indicate that the sac does not undergo its maximal development when its contents are experimentally removed.

Does the fibro-muscular sac depend upon testis hormone for its maintenance? This question was experimentally investigated by removing either one testis or both testes from each of 11 males possessing spermatozoa and functional accessory reproductive or-

³ Wells, L. J., *Anat. Rec.*, 1935, **64** (Suppl.), 138.

TABLE II.
Effects of Removing the Testis from the Sac in Prepuberal Males.
Data expressed as averages for the group.

No. of Animals	Month of Autopsy	Body Wt., gm.	Wt. of one normal intact testis, gm.	Spermatozoa	Weight of fresh fibro-muscular sac, gm.	
					Empty sac	Normal sac
8*	Feb.-Mar.	245	1.0205	Present	.0869	.2014
5†	Feb.-Mar.	240	.8047	"	.0732	.1493

*Unilaterally castrated.

†Unilateral cryptorchidism experimentally produced.

gans. Testis removal occurred on April 2, and the animals were killed 31 days later on May 3. Average weight of paired sacs of bilateral castrates was only approximately 33% as great as that in normal males with spermatid testes (Tables III, I). Weight of the empty sac of unilateral castrates was invariably less than that of the normal one.

That these results were not elicited by destruction of vascular and nervous elements of the sac during the surgical removal of the testes is suggested by the fact that the empty sac weighed only slightly less than the normal one in unilateral castrates. It seems that other factors were operating. Since the average weight of paired sacs from bilateral castrates was less than the average weight of the empty sac of unilateral castrates, one logically assumes that testis

TABLE III.
Effects of Testis Removal on the Fibro-muscular Scrotal Sac in Adults.

Animal No.	Body Wt. at autopsy gm.	Wt. of one testis removed at operation	Wt. in gm. of intact testis at autopsy	Wt. of seminal vesicles, gm.	Wt. of fresh sac in gm.	
					Empty sac	Normal sac
1388*	210	.9318	.9399	.6013	.1304	.1638
1389*	195	.4918	.5155	.9729	.1151	.1527
1391*	215	.7155	.7418	.7838	.1531	.2214
1392*	205	.6461	.6358	.9828	.1538	.1794
1393*	195	.7445	.6738	1.1884	.1341	.1822
Aver.	204	.7059	.7013	.9058	.1373	.1799
1394†	185	.5437		.0496	.0809‡	
1395†	200	.4482		.0926	.0962‡	
1396†	225	.7340		.0598	.1094‡	
1397†	204	.4473		.0691	.1203‡	
1398†	202	.7015		.0431	.1247‡	
1399†	232	.6903		.0657	.1781‡	
Aver.	208	.5941		.0633	.1182‡	

*Unilaterally castrated.

†Bilaterally castrated.

‡Total weight of both sacs.

hormone is a major factor in sac maintenance. Animal 1399 (Table III) is of special interest, however, because the epididymis was removed from the sac on one side, and was left intact in the other; the empty sac weighed 0.0799 gm. while the other weighed 0.0982 gm. That the weight of the empty sac in unilaterally castrated animals is not due to a subminimal amount of testis hormone is suggested by the fact that seminal vesicles were entirely typical of those found in normal breeding males. It seems probable, or at least possible, that some of the decreased weight of sacs in both unilateral and bilateral castrates may be due to a decreased tonus of the cremasteric fibers, perhaps due to an absence of mechanical stress following testis removal.

It is concluded from these results that the ascent of the testes in adults of this species is not primarily due to scrotal failure, since the scrotum appears to be dependent on the testis. Perhaps the decrease in testis weight is the primary factor causing ascent, but the results of the present study do not prove that it is. The evidence suggests that testis hormone is responsible for maintenance of the sac. Decrease in the output of testis hormone, which has been previously found to closely follow testicular regression in normal males,³ could account for the decrease in the weight of the sac. But the character of the functional sac is not entirely determined by testis hormone; mechanical stress produced by mere presence of the testis within the sac appears to be a factor in both development and maintenance of the fibro-muscular scrotal sac. Variation in the weight of the sac is caused by fluctuation in the amount of skeletal muscle. Whether this variation is due to hypertrophy or hyperplasia of muscle fibers is being investigated.

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Amino Acids (Natural and Synthetic) as Influencing Hemoglobin Production in Anemia.

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We wish to submit evidence that histidine and phenylalanine (both natural and synthetic forms) may under certain conditions exert a definite influence upon the regeneration of red cells and hemoglobin in standardized dogs made anemic by blood withdrawal. We have